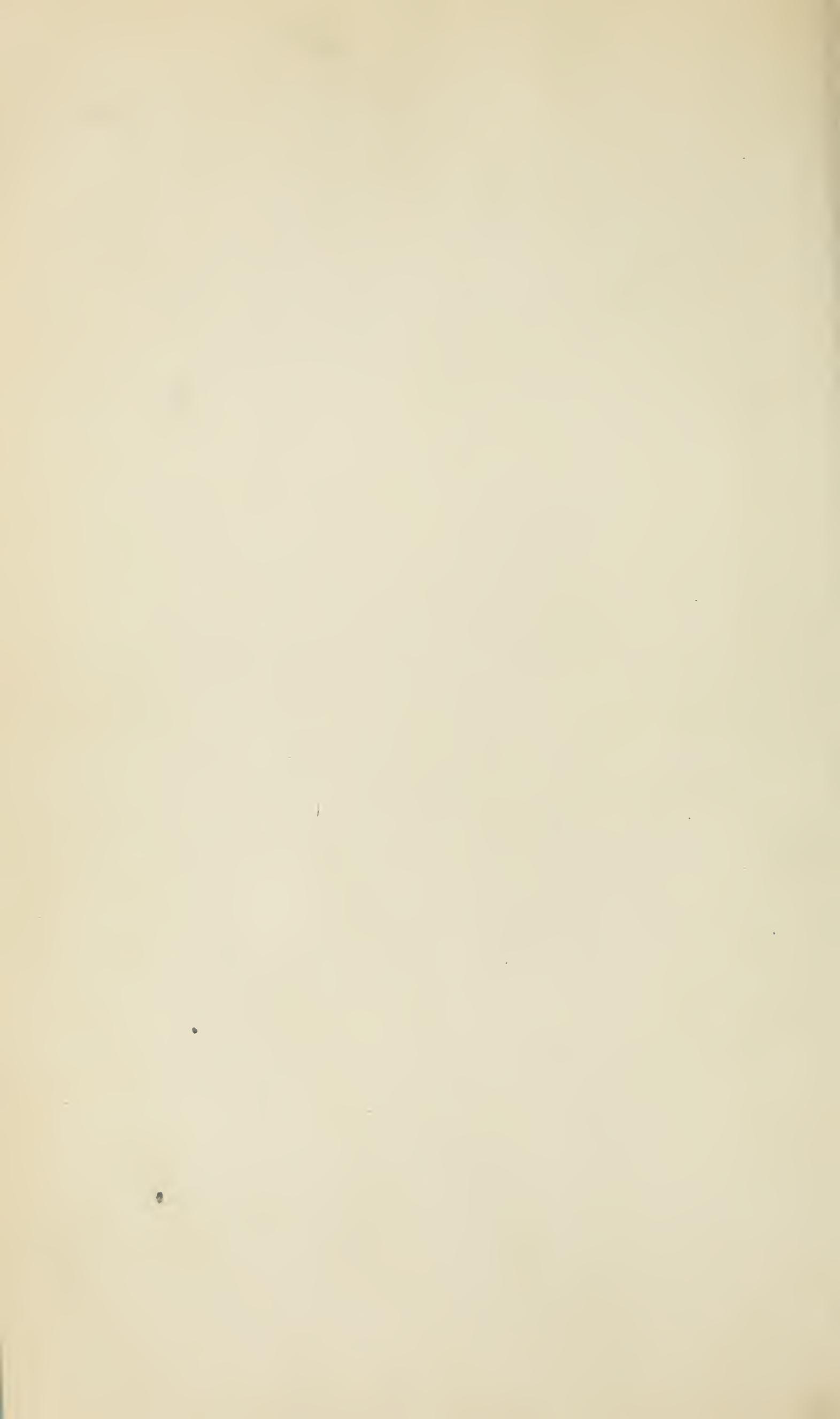


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PORTO RICO AGRICULTURAL EXPERIMENT STATION,
D. W. MAY, Agronomist in Charge,
Mayaguez, P. R.

Under the Supervision of the STATES RELATIONS SERVICE,
Office of Experiment Stations, U. S. Department of Agriculture.

**REPORT OF THE PORTO RICO
AGRICULTURAL EXPERIMENT
STATION.**

1918.

Issued September 17, 1920



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1920.

PORTO RICO AGRICULTURAL EXPERIMENT STATION.

[Under the supervision of A. C. TRUE, director of the States Relations Service, United States Department of Agriculture.]

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LETTER OF TRANSMITTAL.

PORTO RICO AGRICULTURAL EXPERIMENT STATION,

Mayaguez, P. R., March 11, 1919.

SIR: I have the honor to transmit herewith and to recommend for publication a report of the Porto Rico Agricultural Experiment Station, 1918.

D. W. MAY,
Agronomist in Charge.

Dr. A. C. TRUE,
*Director of States Relations Service,
U. S. Department of Agriculture, Washington, D. C.*

Publication recommended.

A. C. TRUE, *Director.*

Publication authorized.

D. F. HOUSTON, *Secretary of Agriculture.*

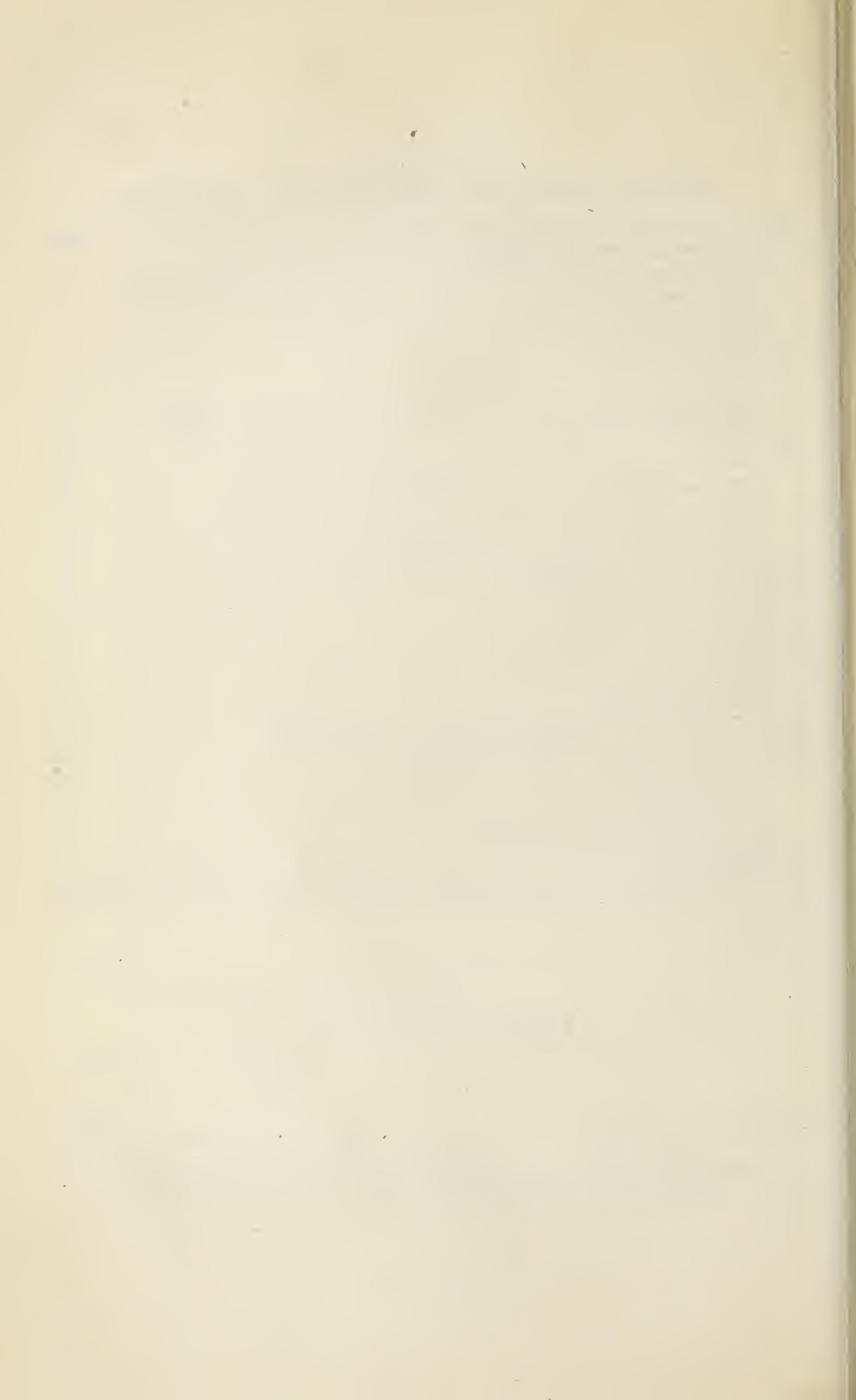
¹ Appointed Nov. 26, 1918, to succeed Philip L. Gile, resigned.

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REPORT OF THE PORTO RICO AGRICULTURAL EXPERIMENT STATION, 1918.

REPORT OF THE AGRONOMIST IN CHARGE.

By D. W. MAY.

INTRODUCTION.

During the year 1918, the station, while pursuing the outlined plan of previous years as regards research, has at the same time carried on considerable work along extension lines suggested by war necessities. It is needless to say that the research work was hampered and delayed to some extent, not only by the urgent demands of immediate food production but also by the calling of the employees of the station into war service. During the year several of the employees entered the Army, while others were transferred to work bearing more or less directly on war needs. As it was impossible to replace these men, it was necessary to carry on the work of the station on a restricted scale till the cessation of hostilities permitted the gradual resumption of normal activities.

The war has brought the people of Porto Rico to a realization of the needs of the island in improved methods and increased production in agriculture. The fear of isolation by submarine activities emphasized the importance of increasing food production by planting vacant lands and by interplanting food crops with the staple crops of the island. Importation of foodstuffs had become so general and their home production so limited that the threatened possibility of being cut off from sources of food supply disclosed the fact that a land of perpetual summer and a continuous growing season might be brought to face the problem of want and possibly starvation. This made the people of the island willing not only to plant and cultivate more land, but to seek new crops and to study the latest methods of improving yields and increasing profits.

Through it all the results of the station experiments have been studied and applied to a greater extent than ever before. Greater progress has been made in agriculture than in any other year of the island's history. Crops heretofore neglected have been taken up, methods formerly ignored have been applied, and unused lands and idle people have been employed in production to a greater extent than ever before.

SUGAR CANE.

Sugar as usual has formed the leading crop, and among exports has exceeded in value all other products. Owing to the unusually high prices brought about by economic conditions throughout the world, great efforts have been made to increase production by every available means.

During the year a serious disease of cane became noticeable, and it is giving grave concern. It appears to be a physiological trouble, and is evidenced by a yellowish or chlorotic appearance of the leaves and a shrinkage of the stalks, general characteristics very similar to those of the yellow striped disease of the East Indies. Studies and experiments are under way to combat it, and, while the outlook is serious, planters are alive to the situation and will lend every assistance possible in keeping the disease within bounds.

There is no doubt, however, that not only to combat disease but to conserve and improve the soils a more rational system of rotation must be followed by Porto Rican cane planters. At present, as the price of sugar is high, many cane growers have extended cane plantings to lands that under normal conditions would not produce sugar at a profit, and it is very difficult to get them to consider any other plan than that of planting good cane lands continuously to cane. Continued losses will induce most planters to plan a wise rotation and reasonable treatment of soils, based upon production through a series of years rather than upon the present market outlook for a single product.

FRUIT.

During the year there was a good production of fruit crops and a high average market, but shipping facilities were inadequate. Owing to the withdrawal of a number of ships for overseas service, the space available for fruit has been very much curtailed, with the result that considerable fruit has failed to reach a market.

Efforts have been made to utilize the fruit by-products. For some years a great many pineapples have been canned, but no use has been made of defective grapefruit and oranges. Many of the latter fruits, though sound and of good quality, are unmarketable because of oversize, unusual shape, or blemished skin. Through the efforts of the experiment station and the fruit exchange, the Bureau of Chemistry, United States Department of Agriculture, cooperated in the matter of trying out on a commercial scale methods of bottling grapefruit and orange juice as developed in the laboratory. The results have proved very promising, and the juices are now being placed on the market with assurances of success. Some work with marmalade is also in progress. The profitable utilization of the waste products of the citrus industry appears to be quite possible.

Groves that have been properly fertilized and cultivated are showing splendid results. On the other hand, groves not receiving proper attention are deteriorating and showing the usual signs of neglect. No other industry perhaps requires such constant and unremitting care as fruit growing. This is especially true in the Tropics, where there is no resting period in the year but where, as with the orange, the blossoms of the coming crop appear before the last of the preceding crop is gathered.

The most serious trouble to the citrus grower at the present time is scab. The station is devoting considerable attention to combating this disease, and with the cause known and considerable data accumulated as to methods of attack the outlook is favorable for overcoming it.

The station receives many inquiries from prospective planters as to the outlook for the fruit industry in Porto Rico. It is difficult to give a general opinion to fit all cases. In the first place the prospective planter should be sure that he will like the life. He should by all means make a visit to the island and learn something at first hand as to the conditions prevailing. Orange growing appeals to many men as an ideal occupation in which they can retire from the active pursuits of life and spend happy days easily picking golden fruits and profits with the least expenditure of effort. Though the difficulties that beset the fruit industry are not insurmountable, it brooks no neglect, requiring constant service, abundant capital before returns can be expected, and constant and unremitting attention always.

COFFEE.

By reason of the war prices for coffee were lowered and markets restricted. This, with a decreased yield, has been a great hardship to the coffee growers of Porto Rico.

The best market for Porto Rico coffee is still in Europe, though Cuba has taken increased amounts of the crop, especially of the better grades that have heretofore gone to Europe. Little progress has been made in selling the coffee in the States, nor is progress likely unless the coffee consumers there change their tastes. Porto Rican coffee is an after-dinner coffee of the highest type, while the great bulk of the coffee consumed in the States is drunk in large cups with cream and sugar where a certain aroma is the first requisite.

Very few new plantings of coffee are being made in Porto Rico, and the older plantings are giving decreasing yields. The industry is declining, and for both cultural and economic reasons it is not likely that it will again approach the position it once held in the island's industries. The soils once devoted to it are in need of a

change to other crops. As these lands are mostly steep, mountainous, and in some cases almost inaccessible, and as only hand labor can be used in the production and harvesting of the coffee grown on them, it is improbable that the industry can thrive in competition with the virgin soil and level lands of other coffee-producing districts where machinery can be used in all the processes of production. Moreover, the advantage given to perishable products in Porto Rico because of its nearness to the markets of the States does not obtain with coffee, which can be shipped from distant points without loss or deterioration.

Coffee will never be again the one crop of the plantations of Porto Rico. The main hope of the coffee grower lies in diversification. While securing such profits as he may from his coffee plantings, he should diligently seek other crops to occupy the idle lands of his plantation and to replace those now planted to coffee when the coffee trees deteriorate to the point where they fail to yield a profit. It is not probable that the coffee of Porto Rico will bring a price enough above that of Brazil to pay the larger cost of production, nor is it possible without expensive artificial manuring to secure yields approximating those of the early days of the industry.

FORESTRY.

Although the island has been largely denuded of its trees, mainly for the purpose of making charcoal, little effort has been made to reforest the areas devastated. There is, however, a growing interest in the matter of tree planting fostered chiefly by the schools. More extended and systematic planting of trees is much to be desired. The station has continued to send out trees and seeds of a few varieties considered of greatest economic importance because of their adaptation to local conditions and future needs and values. Besides the fruits mentioned in other parts of this report, the trees of most promise are the mahogany and eucalyptus, the former probably the more important as it thrives perhaps in a greater variety of situations than any other forest tree so far tried, is unsurpassed as a cabinet wood, and will always have a value, doubtless an increasing one, as the world supplies appear to be steadily diminishing.

On the 200-acre tract of land on the mountain above Mayaguez the work of reforesting has been continued. A number of introduced hardwoods are making good growth, and the trees are steadily extending their covering over the bare mountain side.

For the pasture lands, especially of the south or dry side of the island, the algaroba of Hawaii, introduced under the name *Prosopis juliflora*, is proving a very valuable tree. It affords shade for live stock, and being a legume, it improves the soil while the pods furnish a large amount of palatable food for animals. Its more extensive planting is being urged.

LIVE STOCK.

The improvement of live stock in the island is continuous but slow. The great increase in motor vehicles both for pleasure and for commercial use has caused a slowing up in production of horses and mules, and even the employment of oxen on the plantations and on the roads is decreasing.

The great desideratum of cattle raising is the elimination of the tick. The toll taken by this pest is enormous, and it is the great deterrent to the importation of breeding cattle, the most important feature of the upbuilding of Porto Rican herds. However, there is a general recognition of the importance of eliminating the tick, and following the example of the station, where the first dipping tank was built, the people are now constructing tanks in various sections of the island. When public sentiment and spirit is somewhat further aroused, a reasonable appropriation, backed by the use of the best methods employed in the Southern States, will quickly and easily rid the cattle industry of this scourge.

There is improvement in the pig and poultry stock of the island. Both can be best improved and increased by the greater production of local feeds for their maintenance.

AGRICULTURAL LABOR.

With the continuous increase in agricultural production, systems and methods of farming are changing, especially in the use of labor-saving machinery. The supply of unskilled labor also continues to increase more rapidly than the demands of profitable employment, this being particularly apparent in the interior where coffee has been the main crop. The production of coffee remaining fairly stationary or decreasing while the population of the plantations is steadily increasing, the life of the rural laboring population is hard and their opportunity for advancement practically nil.

The agricultural laborer is called a peon; he usually spends his whole life on the same plantation. The land may be sold but he remains. The owner, who employs the peon when there is work and money to pay the small wage customary, is in a way responsible for him during times of food scarcity and gives him permission to build his shack on the plantation and to cultivate food plants for his own use. The peon is a dependent and is content with a bare subsistence.

In view of the surplus of labor, and in view also of the fact that Porto Rico is one of the most densely populated agricultural regions of the world, having over 300 inhabitants to the square mile, the only way to meet the situation is to increase production. That the island is doing this is shown by the steady increase in value of exports from \$8,000,000 in 1902 to \$70,000,000 in 1918, but at the same

time the population has increased enormously. If the island is to progress, better food, clothing, housing, and education for the people are necessary.

REPORT OF THE HORTICULTURIST.

By T. B. McCLELLAND.

VANILLA.

Considerable progress was made during the year in the work with vanilla. A bulletin was prepared covering the main features of the investigations carried on with this crop in the last six years. A plantation has been established on a commercial scale near the center of the island, and a large nursery planted at the station for supplying cuttings, the scarcity of planting material being all that is retarding the extension of this crop at present. Investigations have included different systems of propagation, the effect of light and heavy pollinations, and different processes of curing.

As covered sections of vine often rot, aerial propagation was tested by simply tying cuttings to a support and leaving them wholly unconnected with the ground. These were under observation for eight months, by which time in most but not all instances roots had developed, this occurring any time after the first month. One aerial root had grown 40 inches in this period. Its maximum rapidity of growth exceeded 4 inches in a week's time. While roots were generally produced by cuttings so placed, their development was much slower than when several nodes of the cutting were covered with leaf mulch, but after the aerial roots entered the mulch the subsequent development of the cutting was entirely normal.

Very pronounced effects on the weight and length of the pod were secured in relation to heavy or light pollinations. The vines were classified in three groups in which, respectively, 2, 4, and 6 pods per cluster were allowed to develop. With the production of an increased number of pods, as shown by the averages for the three groups, there resulted a decrease in weight per pod but an increase in weight of total production, the fresh weight of the average pod being 16.8, 12.7, and 9.9 grams, respectively, for the three groups. The group in which only two pods developed per cluster averaged a greater number of pods per plant of 8 to 9 inches in length for each quarter-inch size than did the group in which 4 pods developed per cluster, while the same held true for the latter group in each length of $7\frac{1}{2}$ to 9 inches when compared with the group in which 6 pods developed per cluster. Individual plants produced pods to the equivalent of 2 pounds of cured beans.

The 1917 crop from a tenth-acre plat, with 42 vines in production, amounted to 36.44 pounds as marketed, occupied a trifle less than 1 cubic foot of space, and sold in New York at \$3 per pound, producing a gross return of \$109.31.

Two small seedlings have been secured from crossing S. P. I. No. 14441 ♀ with a distinctly different variety or possibly a different species, as represented by S. P. I. No. 14442 ♂. The more vigorous of the seedlings measured several inches in height at two years from planting and had by this time begun a thrifty growth (see Pl. I, fig. 1).

COFFEE AND CACAO.

Investigations with coffee have followed much the same lines as in former years.

The transplanting experiment with San Ramón coffee discussed in a publication² of the station continued to show by the past season's crop, three years after transplanting, a difference in favor of the group transplanted with roots incased in a ball of earth from the nursery, the crop from these trees being approximately 10 per cent greater than from the alternating rows, which were transplanted with their roots bare of earth. As this variety shows considerable variation in type after the third-year crop, the less desirable forms were discarded, to be replaced by seedlings from selected trees.

In the planting of *Coffea dewevrei* individual crop records are being kept on trees of special promise, this planting showing an extremely wide variation in type. The tree which has made the maximum growth and given the maximum yield produced in the past season at a little more than six years from seeding, 23.4 liters of coffee cherries. The cup quality of this variety does not equal that of the Porto Rican coffee, but it is fair.

In several cooperative fertilizer experiments on coffee plantations the 1917 crop showed no effect from nitrate of soda applied in varying amounts in February, August, and December, 1916. In a fertilizer test which has been carried on at the station now for eight years, the yield per tree for the past crop averaged 8.4 liters of coffee cherries for complete fertilizer, 5.7 liters for combinations of phosphoric acid or potash with nitrogen, and 2.8 liters for the combination without nitrogen and for the check plat. This is the third crop in which the yields obtained followed in the same sequence—that is, complete fertilizer, the two combinations carrying nitrogen and omitting either potash or phosphoric acid, the combination omitting nitrogen, and the check.

In last year's report an experiment undertaken in the control of the coffee-leaf disease (*Stilbella flava*) is described. The treat-

ment accorded this plat has given excellent results. At the latest inspection, a little more than a year and a half from cleaning out the plat, more than 400 trees were examined and less than 2 per cent of them showed any infection whatever. The infection found was slight and only on trees near the edge of the plat, where infection is always to be expected, as the plat is completely surrounded by diseased growth. That the plat, except on its border, has remained entirely free of this disease for this length of time, and that the trees are making vigorous growth clearly demonstrates the efficacy of the means employed for control of the coffee-leaf disease, which is very disastrous in its effects on coffee production at the higher altitudes.

In the older cacao orchard there has been a fairly steady increase in the annual yields for some years, reaching an average production of $32\frac{1}{2}$ pods per tree for the calendar year of 1917. Provided the planter is able to prevent extensive ravages by rodents, which are very fond of the sweet pulp surrounding the seeds, this crop should come in for commercial consideration, as the returns in Porto Rico compare favorably with those of coffee. Interest in planting cacao is on the increase among coffee planters, and a considerable quantity of seed has been distributed from the station.

MANGOES.

Sixteen varieties of imported mangoes fruited this season, including two which had not fruited previously, Mekongensis and Kistaphal. Properly ripened fruits were not obtained of either of these, such fruits as were secured having dropped prematurely. Their quality was inferior to that of some others of the imported varieties.

Cambodiana, Amini, and Totafari were the most prolific producers. As the high quality of the Cambodiana makes it a general favorite, a knowledge of the character of the seedlings is most desirable. Of seven seedling trees which fruited four were seemingly identical with the parent, one exhibited minor differences, and two varied distinctly from the type, having decidedly more fiber and also differing in other characteristics. One of these had a considerably more rounded cross section than the typical Cambodiana, a slightly more highly colored skin, flesh a deeper yellow, flavor less acid with a trace of turpentine, and fiber up to an inch in length. The fruit was flattened on the dorsal side, and had a pronounced cavity at the base. The flavor was much liked by the individual who tasted this fruit. The seedling trees which varied from type do not include the one reported as fruiting last year, as this failed to fruit this season. The seedling trees of Cambodiana which have fruited show that while in propagation from seed no assurance can be had of securing a fruit identical with this parent variety; the chances are very good for the seedling

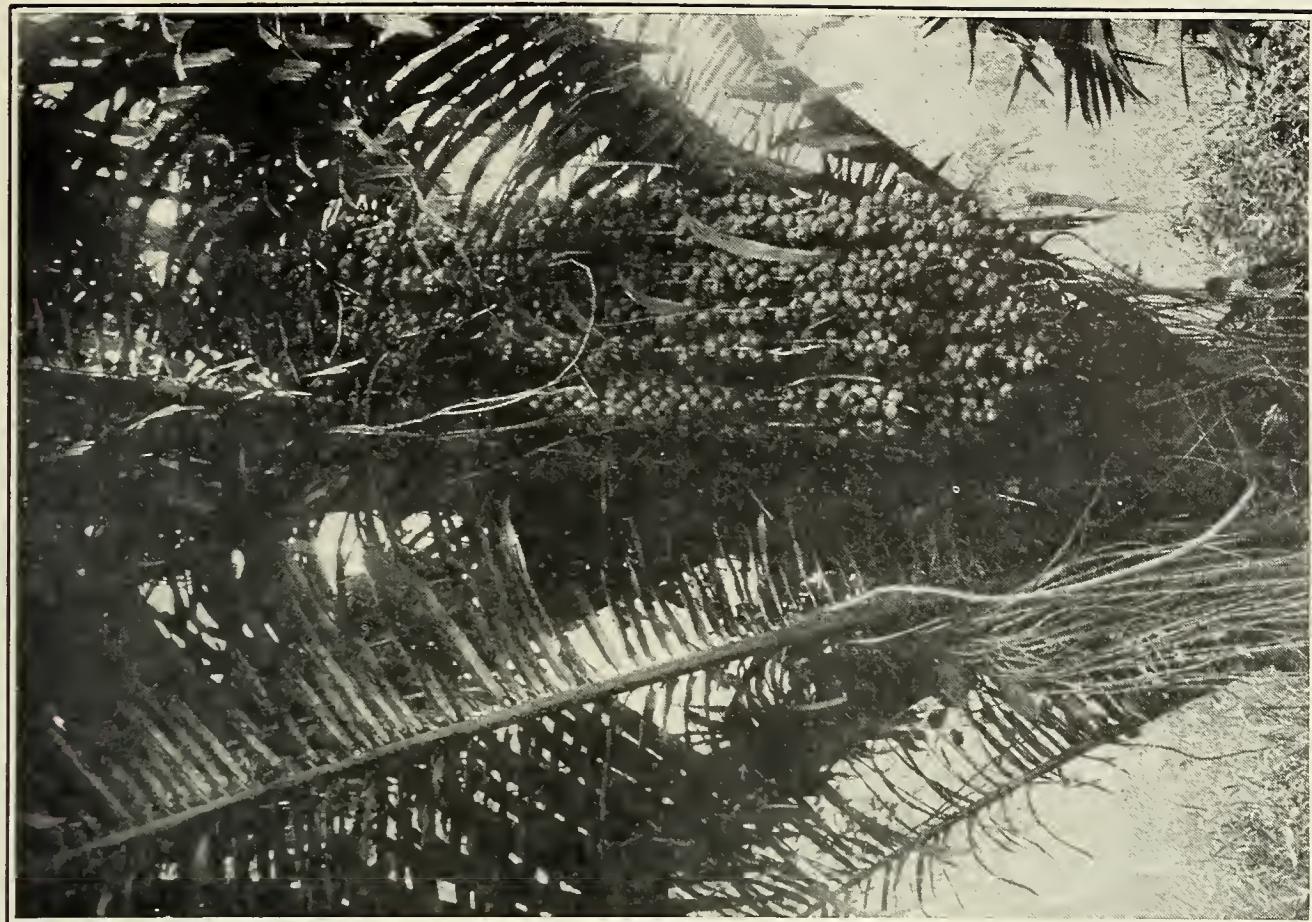


FIG. 2.—SUGAR PALM.

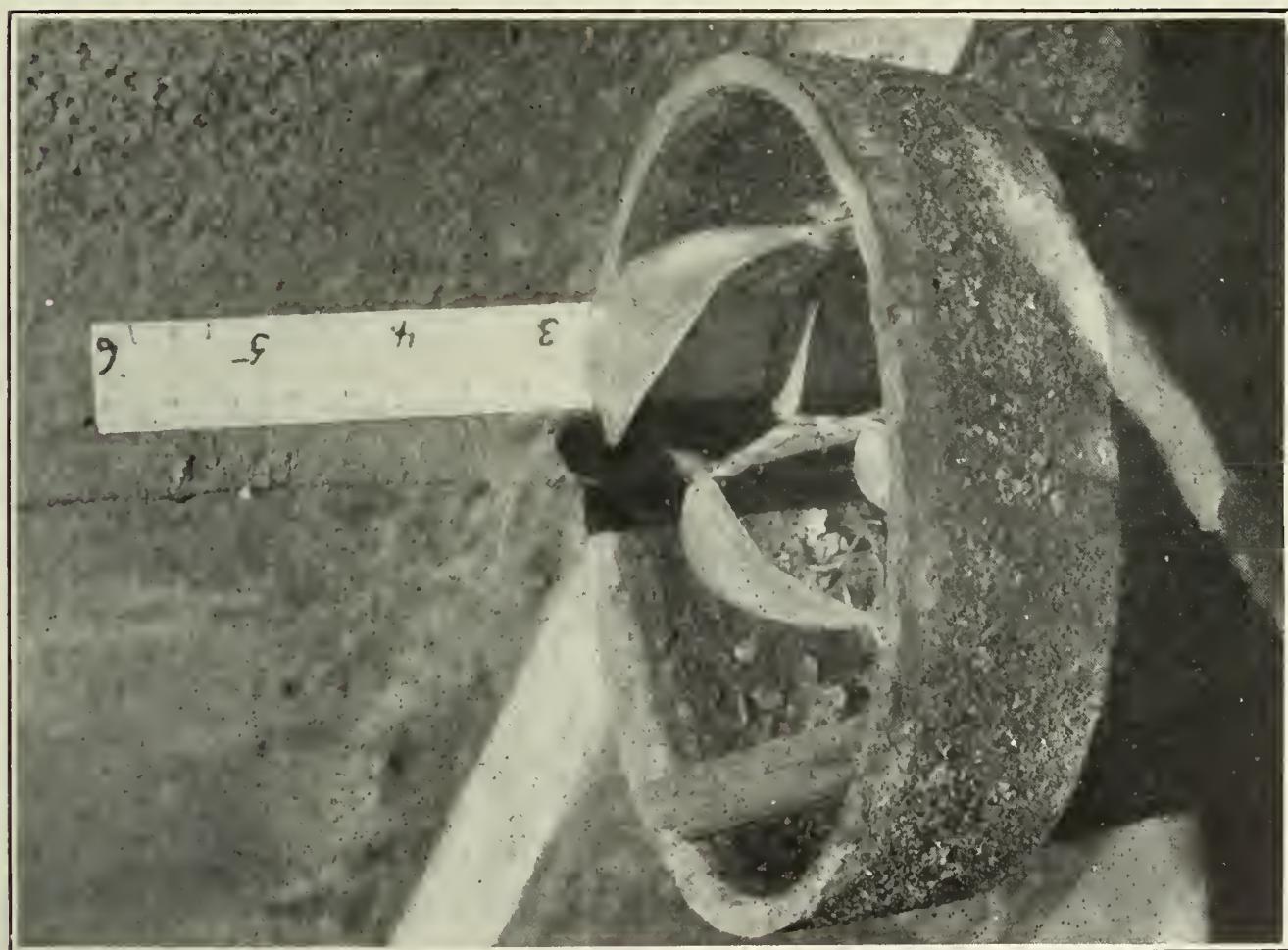


FIG. 1.—VANILLA SEEDLINGS TWO YEARS FROM SEEDING.



FIG. 1.—VARIETY TESTS OF BEANS.



FIG. 2.—MUSSÆNDA PHILIPPICA, AN INTRODUCED ORNAMENTAL.

either to be identical with the parent or, if different, still to retain a flavor of pleasing quality.

The grafted trees are being steadily increased in number in the station orchards and varieties which have proved of high quality are being distributed.

Drying mangoes was tried with success, the dried fruit keeping well for months. Some fruits were peeled and sliced, others were halved and left unpeeled, then placed in the sun for a number of days. The sliced mangoes in drying became exceedingly sticky to handle, but otherwise were more satisfactory than the unpeeled, halved mangoes. The flavor was quite distinctly different from that of the fresh fruit and the taste agreeable, but the appearance very unattractive.

BEANS AND PIGEON PEAS.

The initial planting of an extensive test of bean varieties was made on April 1 (Pl. II, fig. 1). This date is too late for an assurance of best results with beans in this section of the island. Growing conditions were excellent for six weeks, after which heavy and frequent rains flooded the planting to such an extent as to necessitate the harvesting of the immature crop at two months from planting. Nineteen varieties from the mainland of the United States were tested and in addition Santo Domingan, Venezuelan black, Porto Rican red, and Porto Rican white beans. The planting consisted of 60 rows. Blossoming dates, earliness, number of pods per plant, weight of pods, and weight of the shelled beans were recorded.

Mohawk was the earliest to develop pods of sufficient size for eating as green beans, while Porto Rican red, Dwarf Horticultural, and Currie's Rustproof Black Wax were also notably early. Porto Rican white and Venezuelan black beans were very late in blossoming. If single rows are considered, the six leading varieties ranked in descending order as follows in combined weight of pods and beans produced: Venezuelan black, Bountiful, Porto Rican red, Mohawk, Longfellow, and Full Measure. In weight of beans alone the order for the six leading rows was Venezuelan black, Porto Rican red, Bountiful, Extra Early Valentine, Six Weeks Round Yellow, and Mohawk; but if instead of single rows the average for rows of each variety is taken the order becomes Mohawk, Bountiful, Porto Rican red, Dwarf Horticultural, Six Weeks Round Yellow, and Extra Early Refugee. The poorest yields were from Stringless, Refugee Wax, and Round Pod Kidney Wax.

A second planting of 29 rows was made April 23 to test the different varieties under the less favorable conditions of the early rainy season. In this planting the Venezuelan black and Porto Rican red gave best results, followed by Hudson Wax and Porto Rican white

beans. The three most productive rows were of Venezuelan black, with the leading row producing about three times as much as the Porto Rican red and more than five times as much as any northern variety.

A third planting of 30 rows was made May 17 and a fourth planting of 28 rows June 18. In each of these plantings best results were had from Venezuelan black and Porto Rican white beans, showing that of the beans tested these varieties were best able to withstand the very unfavorable conditions produced by the heavy rains, under which many succumb entirely.

Simultaneously with the bean test a number of selected strains of pigeon peas are being tested, this being a crop which is generally planted without any selection whatever though marked differences are found in both pod and seed.

Plantings were also made of several noxious beans grown and sold in the island but these were destroyed by floods before fruiting.

MISCELLANEOUS INTRODUCTIONS.

In the test plat for miscellaneous introductions several plants may be mentioned as showing themselves well adapted to local conditions.

A number of specimens of *Flacourtie gardnerii* have grown into vigorous and prolific shrubs. The flowers are much liked by bees. The fleshy fruit, a flattened sphere about the size of a cherry, is a very dull red approaching black in color with a whitish bloom. The fruit is too acid a flavor to be enjoyed when eaten raw, and jelly made from it, though having a good appearance, is quite acid in flavor with a suggestion of saltiness which renders its quality very poor.

Uraria rufa has grown well. The small, reniform, clustered fruits, shiny red in color and covered with a yellow down which gives them a somewhat artificial appearance, are rather ornamental. The fruit contains 8 or 9 proportionately large seed, each surrounded by a translucent pulp which adheres very closely. The flavor is mildly subacid and the quality poor.

Mussænda philippica is a shrub of very striking appearance and one which would be effective in landscape gardening. One of the five calyx lobes of many, but not of all, blossoms enlarges into a petioled ovate leaf-like form, attaining in some instances a length of as much as $4\frac{1}{2}$ inches and a breadth of more than 3 inches. Its color is creamy white with a little green on the under surface. As this does not drop with the small orange star-shaped blossoms, this shrub remains a conspicuous object over a long period of time (see Pl. II, fig. 2).

Among other introductions which are growing well at the station is the sugar palm. (Pl. I, fig. 2.)

REPORT OF THE ENTOMOLOGIST.

By W. V. TOWER.

From data compiled from a questionnaire sent to the beekeepers of the island it appears that the beekeepers securing the most honey are requeening at least once in two years. Honey reports for the various districts have been compiled and averages worked out. A more detailed account of this work is given below.

Assistance in the storing and fumigation of food products was given to merchants on the island. One large commission house in Mayaguez has built a concrete fumigation room, designed by the writer, who carried on the first two fumigations. Other fumigation rooms should be built, as grains become more quickly infested with weevils in the Tropics than in a temperate climate where there are marked changes in temperature.

A number of inspection trips were made in the past three months to various citrus and cane plantations. The citrus crop for the island was found to be below normal, but most of the fruit was bright and free from rust and scale. Many of the growers have used formulas recommended by the station for scale and rust mite.

BEES.

There has been a falling off in the production of honey per colony for the last few years, which is attributed to the increased number of apiaries and colonies to a given locality. When the price of honey dropped at the beginning of the war, the beekeepers did not give their apiaries the care which they had previously given them.

There is a tendency among some beekeepers to requeen not oftener than once in three years. This is a very poor practice, especially in the Tropics. The queens have to work all the year round and become exhausted much sooner than in a colder climate. Queens should be changed every 18 to 24 months.

From replies returned to questionnaires it is apparent that the majority of the beekeepers on the island do not practice a systematic building up of their colonies for the coming harvests. The working force of bees should be built up to their highest strength just before the harvest begins. This can be accomplished by introducing young queens, as they are more active than the older ones and produce more brood. Careful manipulation of brood and judicious feeding help to produce strong colonies. The early removal of drone comb to supers is an excellent practice, and in its place full sheets of brood foundation may be inserted, or drawn-out brood combs may be given with even better results. Strong, young colonies have often been seen to store more honey than full colonies with old queens.

The apiarist should make a study of the flora of his locality, keeping a record of the honey flows in order to be able to bring his bees to full strength for the various flows. It is difficult to do this in Porto Rico on account of the irregularity of the various blooms, but

it can be done. At extracting, each hive should be credited with the number of frames of honey produced so that the beekeeper may know the colonies which fall behind and may also determine the colonies from which to breed.

CITRUS.³

The island's cultivated and wild crop of citrus for 1918-19 has been estimated at from 60 to 70 per cent of normal production, the present shortage being accounted for by the severe drought of the past winter and spring. The Manati and Barceloneta districts suffered most, as in many cases the early bloom dropped and the second, or May bloom, as it is termed, set poorly. The late bloom in many sections did not appear until June or July, and there was observed a heavy September bloom of oranges. The oranges and grapefruit blossomed very irregularly during the past year. The late blooms will mature in February and March, at which time the fruit should be bright and attractive.

The citrus growers of the island should raise more legumes in their groves to supply part of the nitrogen to the soil and also to prevent washing. These may be grown during the summer months when there is an excess of moisture. The crops should be cut in the fall and turned under. Working the grove at this time will, no doubt, hasten the ripening of the fruit. Care must be taken not to grow cover crops in the winter months unless there is plenty of rainfall, especially in groves that are producing fruit. The turning under of the various legumes not only adds nitrogen but puts the soil in better physical and mechanical condition, so that the fertilizers applied will be more readily taken up by the plant.

In a number of fruit districts central packing houses have been built, enabling the growers to bring together a greater quantity of fruit under one brand, to make a more uniform pack, and to reduce the overhead expenses. The growers who deliver their fruit to a central packing house have the advantage over those who pack their own fruit in that they can use their men during the packing season in their groves getting them in condition for the coming season. It also relieves the labor situation during the cane-cutting season, when it is so difficult in most districts to get men for the groves. Many planters who pack their own fruit have to give up all work in their groves during the packing season.

WHITE GRUBS.

Cane fields badly infested with white grubs should not be replanted for six months and the land should be plowed in the meantime. This gives an opportunity to thoroughly prepare the land. Such fields may be planted to cover crops between the time of cutting and planting, and such a practice would be beneficial to the coming crop. It

³ Since the transfer to the Bureau of Plant Industry of C. F. Kinman, former horticulturist, the entomologist has been in charge of the citrus projects of the station.

has been found that hogs and poultry following the plow consume great quantities of grubs. Birds should be encouraged to follow the plows. Bird boxes placed around cane fields would attract them at nesting time. Various leguminous trees may be planted near cane fields to attract birds so that they will nest and roost near the fields.

TICKS.

Owing to the work done by the former entomologist in his studies on tick eradication, the island is beginning to realize the importance of eliminating the tick. The extension office of the station at San Juan, in cooperation with the food commission, has started a campaign to eliminate the tick as far as possible. It is reported that some 60 dipping vats are to be built, which is a fine beginning.

MISCELLANEOUS NOTES.

Porto Rico can not be too strict in her plant quarantine regulations, as there are a number of very serious pests in countries near at hand which, if introduced, would completely ruin some of her industries. For instance, the Mediterranean fruit fly should be kept out, as it would mean ruin to the coffee, citrus fruit, and vegetable industries if established here. A new pineapple weevil has been found in Jamaica and should be guarded against. The depredations of the black fly in Cuba have caused that Government to appropriate \$50,000 for its extermination. The cucumber fly could be kept out, and citrus canker of the Orient and southern United States must be carefully watched.

REPORT OF THE ASSISTANT CHEMIST.

By J. O. CARRERO.

During the year further progress of the work planned in the chemical department was greatly curtailed by the resignation of the chemist, Mr. P. L. Gile.

A small amount of analytical work was done during the year, comprising mainly the quantitative analysis of plant ashes for three or four constituents, as well as the quantitative examination of various materials, such as manganese, copper, and iron ores; drainage and well waters; and dipping fluid from the station vats. Materials such as pyrites, manganese, and copper ores, and kaolin, which required only a qualitative test, were also examined.

Previous to his departure from the station, Mr. Gile brought to a close the work on lime-induced chlorosis.

Work on plant nutrition as affected by the number of roots in the nutrient supplied was also finished.

By far the largest share of time was spent in further studies of the relative efficiencies of the different phosphates in native soils.

The work progressed considerably during the year. Thus far nine soils have been investigated. Work on the last of the series planned is in progress and results on this last experiment will be obtained early next year. This work will include tests of bone meal, floats; slag, and double superphosphate in limed and unlimed soils when the fertilizer was added immediately before planting or several weeks previous to planting.

The attention of this department was called to the difficulty encountered in the bleaching of the Panama straw (*Cardulovica* sp.). Hats made from this straw are as light as those made from the native variety, they wear longer, and command a higher price in all markets, but owing to the difficulties met with in bleaching the Panama straw and the poor quality of the resulting fiber, it had failed to gain a foothold with native planters and weavers. The idea, therefore, was to evolve some cheap and easy method of bleaching which would be within everybody's reach and which could be successfully applied. This has been accomplished, and a very satisfactory grade of straw has been obtained at the station by the use of this method. It is still in need of some further investigation, straw being occasionally met with which is brittle and snaps in the weaver's hands. This may be due to two causes—too tender leaves being used or too thorough application of the treatment; but owing to the scarcity of material, it has not been possible to determine which of these is the exact cause of the brittleness in the dried leaves. It is expected, however, that as soon as some working material is available this objectionable feature of the prepared straw will be eliminated. Mr. Rafael Vidal, who is conducting fiber investigations for the Bureau of Plant Industry of the United States Department of Agriculture in cooperation with the station, gave valuable suggestions and assistance in the prosecution of the work.

REPORT OF THE ASSISTANT IN PLANT BREEDING.

By W. P. SNYDER.

This department has little work to report for the past year, owing to the fact that the writer was on leave in military service after February 1, 1918.

A second planting was made of varieties of Indian wheat in November, 1917, but the planting was badly injured by the changa and no record of yields was obtained. A former planting, made in the spring, was largely a failure on account of wet weather during the ripening period. Some of the varieties merit further trial, which should be made during the dry season.

Selections from several varieties of beans, made in the spring of 1917, were planted in December of that year, and these plantings were harvested and subsequent plantings made by the horticultural department. Two distinct strains of the black Venezuelan bean have

been found, one characterized by very dark green foliage with dark red stems and leaf veins, the leaves having a smooth, regular surface, while the other strain shows a light green color both on stems and leaves, usually with complete absence of the reddish markings, and has crinkly leaf surfaces. Several selections made from both strains have shown considerable variation in yield, some being very productive. Plantings of unselected seed of the black Venezuelan bean have proved consistently more productive than similar plantings of native, Santo Domingan, and mainland varieties.

Ten varieties of tomatoes were planted on September 15, 1917, and set in the field in early December for the purpose of making a variety test and for experiments in crossing certain varieties. However, with the limited amount of time available for the work, no crossed fruits were obtained. The crop was harvested and yields recorded by the horticultural department. The planting consisted of 32 rows of 25 to 30 plants each. The plants were trained to stakes and pruned to about three main branches. The following is a condensed record of the harvest:

Results of variety test of tomatoes.

Variety.	Number of rows planted.	Date of ripening of first fruit.	Average number of fruits per plant.	Average weight of fruit per plant. <i>Pounds.</i>	Average weight per fruit. <i>Pound.</i>
Trophy.....	1½	Jan. 23	17.9	4.35	.24
Carter's Sunrise.....	10	Jan. 17	23.9	2.33	.10
Red Pear.....	1½	Feb. 23	119.4	2.32	.02
Crimson Cushion.....	½	Feb. 16	5.5	2.21	.40
Lorillard.....	11	Jan. 20	12.4	2.08	.17
Native tomato.....	½	Mar. 2	19.2	2.05	.11
Ponderosa.....	4	Jan. 18	4.3	1.81	.42
Stone.....	1	Jan. 28	7.6	1.81	.24
Bonny Best.....	1½	Jan. 30	8.0	1.55	.19
Earliana.....	1	Jan. 9	5.9	.85	.15

Plans for the present year include, in addition to the continuation of lines of work already begun, the raising of seedling canes, variety crossing, and bud selection with grapefruit, and experiments in the production of vegetable and flower seed.

The mottling disease of sugar cane is proving very destructive to the commercial varieties now grown, and one of the most imperative needs of the cane industry in Porto Rico is the control of this disease. Varieties of sugar cane are quite variable in their susceptibility to the disease, and it is with the hope of producing a profitable resistant variety that the work of raising seedlings is undertaken.

Two methods of improving grapefruit varieties are planned; bud-wood selection based on records of tree performance and crossing of the Duncan and Triumph varieties. The latter method, while requiring a greater length of time and being more uncertain, has the advantage of giving a much greater variation of types from which to select than the asexual method of propagation.

Porto Rico is handicapped at present by the necessity of securing many vegetables and flower seeds from the States. Experiments will be undertaken to determine the possibility of producing such seed in the island during the dry season and to compare Porto Rican grown seed with seed from the States.

REPORT OF THE SPECIALIST IN FARM MANAGEMENT.

By H. C. HENRICKSEN.

INTRODUCTION.

The emergency food-production work in cooperation with the Food Commission and the Department of Education was continued during the year. While the chief aim was to increase the production of food crops during the war, it was found possible also to collect many data that will serve as a basis for future investigations.

An assistant engaged by the station and others of the staff—38 men—were employed by the Food Commission and the Department of Education.

As a direct result of the year's work, 1,160 agricultural committees were formed by July 1, 1,741 agricultural meetings were held, and 500 field demonstrations were conducted. The demonstrations were along the following lines: How to improve worn-out land by growing leguminous cover crops; how to obtain larger yields by certain preparation of the soil; the difference between good and poor cultivation; the value of manure and compost and how to make the latter; the right way compared with the wrong way of planting different crops, and the value of seed selection. Field experiments were conducted with a few crops, where there appeared to be an immediate necessity for certain data.

Potatoes were planted in 30 different localities with the object of finding the best-adapted varieties and whether or not this crop can profitably be produced. The seed used for the first series of experiments was bought in the open market from a lot imported from Spain. Four varieties were ordered from the States, but did not arrive on account of traffic congestion. It then became necessary to plant such potatoes as could be bought, regardless of variety. For that reason no data were obtained on varieties except that the American-grown potatoes seemed very much better adapted to Porto Rico than the Spanish. The yields reported were very variable, and more work along that line will be needed. It is worthy of mention, however, that the planting of these plats created an interest among the people and many acres were planted in localities where the cultivation of the crop was previously unknown. Only a few scattered small plats of potatoes had been grown in the mountains in former years, but this year 760 acres was planted, and the results were so encouraging that a large increase is predicted for next year.

Soy beans were distributed for trial in all municipalities and the yields reported were uniformly good. It is doubtful, however, whether plantings will be continued, as the value and use of the bean is not well enough known in the island. The pinto bean was introduced and tried, especially in the drier districts. The first trials did not give striking results, but plantings are being continued.

Notes were obtained on many other crops, such as Sudan grass, peanuts, castor beans, etc., and the data are available for further investigations.

TICK ERADICATION.

A vigorous campaign for exterminating the cattle tick was conducted. Plans were outlined for the number of dipping tanks needed for the island as well as for an organization to conduct the work. It was estimated that the tick could be exterminated at a cost of approximately 50 cents per head of live stock infested. On account of the high cost of materials, systematic work was deferred until after the war, but as a result of the propaganda 10 tanks have been built by private or cooperative effort and 80 additional tanks have been promised.

AGRICULTURAL STATISTICS.

An efficient statistical service has been built up. The difficulties usually encountered when starting such work were gradually overcome and the data are now well within the limits of probable error.

Special attention was given to the 10 main food crops, as shown in the following table:

Acreage planted to 10 important food crops during 1917-18.

Crop.	September. ⁴	October.	November.	December.	January.	February.
Red beans.....	7,626	3,849	3,150	2,783	2,250	4,476
White beans.....	12,345	4,262	2,632	2,840	2,397	3,289
Cowpeas.....	6,515	2,200	566	343	446	708
Pigeon peas.....	13,435	3,194	859	827	682	1,670
Corn.....	36,923	9,456	1,812	926	981	4,141
Rice.....	12,009	2,201	410	93	32	211
Sweet potatoes.....	28,596	8,005	4,157	3,035	2,539	3,798
Yautias.....	9,977	2,449	917	930	970	1,858
Cassava.....	5,723	2,428	1,152	855	764	1,192
Yams.....	3,423	1,067	419	555	714	1,011
Total.....	136,572	39,111	16,074	13,187	11,775	22,354

Crop.	March.	April.	May.	June.	Total.
Red beans.....	7,922	9,583	7,977	1,500	51,116
White beans.....	6,042	9,458	7,356	1,906	52,527
Cowpeas.....	1,212	1,910	2,268	947	17,115
Pigeon peas.....	2,999	4,875	3,527	2,009	34,077
Corn.....	11,239	16,197	16,595	5,307	103,577
Rice.....	902	2,594	5,868	3,344	27,664
Sweet potatoes.....	4,055	4,788	5,749	5,322	70,044
Yautias.....	2,781	3,428	3,036	1,706	28,052
Cassava.....	1,326	1,739	1,875	1,250	18,304
Yams.....	973	1,305	888	327	10,682
Total.....	39,451	55,877	55,139	23,618	413,158

⁴ Planting up to September.

Two sets of data were tabulated monthly, one showing the acreage planted in each municipality during the previous month and another showing the probable yields to be harvested during the current month. The latter estimates were at the beginning based upon average yields for the whole island with deductions according to reports on crop conditions during the growing season. This was found to be incorrect by reason of the fact that the average yields were not correctly reported. Average yields are now being worked out for each municipality by actually weighing the crops from a large number of measured areas. These averages from a municipality are then being used as a basis of estimates for that municipality only. This work is not yet completed, but the figures will be very valuable as comparative data a few years hence.

The following crops were reported upon once during the year:

Amount of five important crops planted in season 1917-18.

Bananas-----	plants--	41,514,806
Plantains -----	do-----	7,617,397
Coconuts-----	trees--	736,091
Potatoes-----	acres--	760
Peanuts-----	do-----	340

The main crops—sugar, coffee, tobacco, and fruit—are not included partly because other agencies are gathering the statistics.

Number of live stock in Porto Rico in January, 1918.

Cows-----	106,951
Bulls-----	121,849
Calves -----	94,601
Horses-----	62,463
Mules-----	9,154
Pigs-----	102,176
Goats-----	48,930
Poultry-----	970,598

The above table shows the total for the island, but the tabulation was made for each municipality. The figures are believed to be correct within the limit of probable error in such work, with the possible exception of poultry.

PUBLICATIONS.

The following publications were prepared in Spanish, mimeographed, and sent to all agricultural agents, agricultural committees, school supervisors, agricultural teachers, and individuals especially interested:

LECTURES.

- No. 1. Feed Your Soil if You Want it to Feed You.
- No. 2. Increase Production.
- No. 3. Gardening.
- No. 4. Seed Selection.
- No. 5. Potatoes.
- No. 6. Bat Guano as a Fertilizer.
- No. 7. Kill That Tick.
- No. 8. Poultry.

CIRCULARS.

- No. 1. Storage of Grains.
- No. 2. Sudan Grass.
- No. 3. Velvet Beans.
- No. 4. Peanut Butter.
- No. 5. Soya Beans.
- No. 6. Castor Beans.

CHARTS.

- No. 1. Imports, 1917.
- No. 2. Exports, 1917.
- No. 3. Planting Table.

POSTERS.

- Kill That Tick.
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REPORT OF THE AGRICULTURAL TECHNOLOGIST.

By W. A. MACE.

The work along various lines of extension begun by the writer last year were continued, and considerable progress has been made. However, more attention has been given to investigational than to demonstration work during the present year. This statement holds true for the work carried on in different parts of the island as well as for that which has been done at the station. The work on the various demonstration plats planted on the island was so conducted as to permit a study of the numerous problems encountered with the different crops. During the first part of the present year a good deal of time was spent in the fields of the corn district instructing the planters in the selection of seed corn. Much interest was displayed by the farmers, and a good quantity of seed was secured for the next planting.

A great number of Farmers' Bulletins and other agricultural publications were distributed among the farmers, where it was deemed that they would be appreciated and studied. Quite a quantity of seeds and plants was also distributed. Farmers in the vicinity of the station were allowed to dip their cattle in the station's dipping tank for destroying the cattle tick. Many took advantage of this opportunity and as a result were much pleased to see their cattle increase in weight, give a higher milk yield, and show a general improved appearance. It is hoped that this is the beginning of an organized campaign for the eradication of a pest which causes great losses to the cattle industry of the island.

The investigational work at the station has been with rice, beans, soy beans, corn, and forage crops, the greatest effort being with rice, covering variety tests and date of seeding. The work with the other crops is that of testing different varieties by comparison. In this work 3 varieties of corn, 9 of soy beans, 4 of field beans, 7 of cowpeas, and about 150 of rice were used.

During the last year five unsuccessful attempts were made to inoculate the soil at the experiment station with nitrogen-fixing bacteria for soy beans. In April of this year some pure cultures of

these bacteria were received from the United States Department of Agriculture and were successfully used, almost all roots of the plants being literally covered with nodules.

Though in the field work much greater efforts have been expended on rice than on any of the other crops, some plantings have been made of soy beans for variety tests and for demonstration, and of field beans and corn for testing rates of seeding and cultural methods. In the rice work, about 130 acres have been planted in fields, varying from 1 to 20 acres in size, in different parts of the island, altogether 16 field plantings being made. One field was used for increasing the seed of several varieties. Two small plantings were made on hillsides for comparing the pure-bred seed with that of the native rice grown in Porto Rico. In the other fields studies in preparation of the seed bed, rate of seeding, depth of planting, and several phases of irrigation were made on plats varying from $\frac{1}{2}$ to 1 acre in size. For this work the experiment station purchased a seed drill, reaper and binder, thrashing machine, and milling outfit for demonstrating the handling of this crop on a commercial scale. The rice grown on this island heretofore, with a single exception, has been in small hillside plantings where the work of the entire crop from planting to milling, inclusive, was done by hand.

Owing to the unevenness of the ground, which was in most cases old cane-field land with ditches and high beds, it was impossible to get the land leveled down properly. This made it impractical to submerge all of the land without getting too great a depth of water in some parts. For this reason what would seem to be maximum yields will not be secured, though some of the fields will give very good returns. The hillside plantings made by the station are showing up decidedly better than the native varieties which were planted at the same time under the same conditions. The work as a whole is sufficiently promising to warrant a continuation of the investigation with this crop, as it promises to be of considerable profit. It is confidently felt that this crop can be used in a system of rotation with beans and cane for conservation of soil fertility and for control of plant diseases and insect pests, and that it can be grown on vast areas which are now lying idle because they are too wet at certain seasons of the year for a long-season crop like cane, but which, if planted to a short-season crop like rice during the time when the rainfall is not so heavy, could be made to produce a successful crop by controlling the water for flooding the fields. A very important fact in this work is that the Porto Ricans are a rice-eating people, and rice should, therefore, be produced on the island as one of the principal crops.

The work of the station with rice has been carried on in cooperation with the Office of Cereal Investigations, United States Department of Agriculture, C. E. Chambliss, of that office, having made two trips to Porto Rico in supervising the work.





